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CONSTRUCTING, MAINTAINING, AND USING PLANT GROWING STRUCTURES. HORTICULTURE-SERVICE OCCUPATIONS, MODULE NO. 7.
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ONE OF A SERIES DESIGNED TO PREPARE HIGH SCHOOL STUDENTS FOR HORTICULTURE SERVICE OCCUPATIONS, THIS MODULE HAS AS ITS MAJOR OBJECTIVE TO DEVELOP THE ABILITIES NEEDED TO CONSTRUCT, MAINTAIN AND OPERATE PLANT GROWING STRUCTURES. IT WAS DEVELOPED ON THE BASIS OF DATA FROM STATE STUDIES BY A NATIONAL TASK FORCE. SUBJECT MATTER AREAS ARE (1) PLANT GROWING STRUCTURES AND EQUIPMENT IDENTIFICATION AND USE, (2) PLANT GROWING STRUCTURE CONSTRUCTION, (3) PAINT SELECTION AND APPLICATION, (4) GLAZING, AND (5) GREENHOUSE CROP GROWING. THE MODULE IS SCHEDULED FOR 21 HOURS OF CLASS INSTRUCTION, 102 HOURS OF LABORATORY, AND 50 HOURS OF OCCUPATIONAL EXPERIENCES. SUGGESTIONS ARE INCLUDED FOR INTRODUCTION OF THE MODULE, SPECIFIC UNIT OBJECTIVES, SUBJECT MATTER CONTENT, TEACHING-LEARNING ACTIVITIES, INSTRUCTIONAL MATERIALS AND REFERENCES, AND EVALUATIVE CRITERIA. TEACHERS WITH A BACKGROUND IN HORTICULTURE MAY USE THE MATERIAL TO PLAN A UNIT FOR LESS ABLE HIGH SCHOOL STUDENTS WITH AN OCCUPATIONAL GOAL IN ORNAMENTAL HORTICULTURE. THIS DOCUMENT IS AVAILABLE FOR A LIMITED PERIOD AS PART OF A SET (VT 000 619 - 000 631) FOR $7.25 FROM THE CENTER FOR VOCATIONAL AND TECHNICAL EDUCATION, THE OHIO STATE UNIVERSITY, 980 KINNEAR ROAD, COLUMBUS, OHIO 43212. (JM)

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CONSTRUCTING, MAINTAINING, & USING PLANT GROWING STRUCTURES

One of Twelve Modules in the Course Preparing for Entry in
HORTICULTURE - SERVICE OCCUPATIONS

Module No. 7

The Center for Research and Leadership Development
in Vocational and Technical Education

The Ohio State University
980 Kinnear Road
Columbus, Ohio, 43212

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M E M O R A N D U M

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DATE: August 7, 1967

RE: (Author, Title, Publisher, Date) Module No. 7, "Constructing, Maintaining, and Using Plant Growing Structures" The Center for Vocational and Technical Education, August, 1965.

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Occupational Focus Service workers at nurseries, garden centers, greenhouses, etc.
Geographic Adaptability Nationwide
Uses of Material Instructor course planning
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Background in horticulture
Student Selection Criteria Designed for the less able high school student, goal in horticulture service occupations.
Time Allotment Estimated time listed in module. (P)

Supplemental Media --
Necessary x
Desirable
(Check Which)

Describe Suggested references given in module. (P)

Source (agency)
(address)

CONSTRUCTING, MAINTAINING, AND USING PLANT GROWING STRUCTURES

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CONSTRUCTING, MAINTAINING, AND USING PLANT GROWING STRUCTURES

Major Teaching Objective

To develop the abilities necessary to construct, maintain, and operate plant growing structures.

Suggested Time Allotment

At school		
Class instruction	21	hours
Laboratory experience	102	hours
Total at school	123	hours
Occupational experience	50	hours
Total for module	173	hours

Suggestions for Introducing the Module

For best growth, plants require specific environmental conditions. The temperature, moisture, light, and air requirements of plants vary. In order to aid in controlling these factors, various types of plant growing structures are used.

A teacher can introduce the students to the idea that structures are needed to control the growing environment of plants. The teacher can point out that when the sun becomes too hot, we seek shade; when it rains, we seek shelter; when we are outdoors and become cold, we build a fire. Why do we do this? We are living things, and as living things we have certain environmental requirements. We have found that by building shelters, such as homes, schools, office buildings and factories, we are better able to control our environment.

Plants are also living things and require certain environmental conditions for best growth. Certain structures have been devised to help control the environmental conditions in which plants are grown. In many areas of the country horticulturalists depend on plant growing structures.

Students may be asked to list any plant growing structures they are familiar with. Relying on student related information, discuss the uses of these structures. Appoint a "secretary" to take notes which later will be compared to this module.

Plants have various environmental requirements and unless a greenhouse is large enough and constructed properly, only similar types of plants can be grown. Often well-wishers will bring in many and varied plants. Plants might be tropical, semi-hardy or hardy. They could not successfully be

grown in a greenhouse providing only one kind of environment. A greenhouse designed for more than one environment should be arranged so each section can be heated, ventilated, and otherwise managed independently from other sections.

A school greenhouse, or lathhouse, or both can be a valuable asset to a horticulture or agriculture department, the school, and the community if sufficient planning, careful programing, and operational procedures are carried out.

A successful school greenhouse must be a suitable type and size. Plants require daily, and often more frequent care; therefore, someone must be willing and able to operate the greenhouse seven days (and nights) a week. Various mechanical greenhouse controls can minimize, but not eliminate the work.

A greenhouse or lathhouse too small to provide practical vocational experience for horticulture or agriculture classes has little educational value. Sufficient space must be provided to accomodate all students with pertinent and practical experience.

Competencies to be Developed

I. To develop the ability to identify various types of plant growing structures and their equipment and to understand their uses

Teacher Preparation

Subject Matter Content

Specially built structures for growing plants have been in use for quite some time. Even before the time of Christ, the Romans dug pits which they heated with manure and covered with a clear piece of mica. In these pits, they forced vegetables and roses used for festive occasions.

One greenhouse in New York was built in 1795. Several years later, George Washington had a similar structure built at Mount Vernon. These early greenhouses were quite different in appearance than modern greenhouses. They had glass walls, but a wooden roof. Not until after the Civil War were any significant changes in greenhouse designs made. A greenhouse is a structure designed for the purpose of creating an environment for year round culture of plants.

When we mention plant growing structures, attention focuses on the greenhouse, but actually, there are a number of other types of structures used. In some areas lathhouses, hotcaps, coldframes, and hot beds are more necessary then greenhouses.

Hotcaps

Some people plant tomato plants while there is still danger of frost. When frost threatens they protect those plants by covering them with baskets, cans, jars, or other materials. These small protective structures enable the plants to be started much earlier in the season. Commercially designed structures which provide the same advantages are available. These "hotcaps" or "hot-tents," are plant growing structures because they help to control environmental conditions.

Lathhouses

Some plants grown outdoors require protection from the sun. Structures called lathhouses are used to provide the needed shade. They are of a more or less permanent construction. The availability of materials influences their design. One common method of construction is to sink posts into the ground. A support frame is built on these posts and common snow fencing is unrolled on the framework and fastened down.

Clothhouses

Clothhouses are used in the outdoor production of crops which must be protected from insect damage. Asters are often raised in clothhouses which act as barriers to the leafhopper transmitting a virus disease known as "yellows."

The Coldframe

Probably one of the most widely used plant growing structures is the coldframe. It is inexpensively and easily constructed.

Because the heat from the sun is used to heat the coldframe, its use is limited to those months of the year when the temperature does not drop too low. It is extensively used by growers of vegetable and bedding plants.

Hotbed

A hotbed is actually a coldframe which is heated artificially. Construction may vary to some extent enabling more efficient heating. A hotbed is more versatile than a coldframe since it can be used for a longer period. On the other hand, it is more costly to construct.

Coldframe and hotbed designs are similar. Usually, standard 3' x 6' sashes are used. A slope of about 6 inches from back to front is necessary to provide proper drainage.

The beds should be located where they are partially shielded from the wind, but fully exposed to sunlight. The slope of the sash should face south to take advantage of all available light, since sunlight is usually a limiting factor during the months the beds are in use.

Sash Greenhouses

A sash greenhouse is the step between a hotbed and a greenhouse. It is basically a double (back to back) hotbed which is raised slightly to permit a person inside to stand upright. Some sash houses have the walk dug out in order to allow a person to stand upright and yet to keep the height of the structure low and out of the wind as much as possible. Ease of construction, and low cost are factors in favor of sash greenhouses.

Heating can be solar and/or artificial. Any heating system used in greenhouses can be adapted to the smaller scale of the sash greenhouse.

Glass Greenhouse

A glass greenhouse is usually considered the most permanent type of glass plant growing structure. Since they are permanent, various mechanical and automatic devices can be incorporated in the operation of the greenhouse.

Greenhouses usually are heated or cooled for year around operation and must have a sufficient number of ventilators to allow for temperature control. Greenhouses and other growing structures may be heated by:

1. Steam
2. Hot water
3. Forced air (Mostly used in small plastic houses and other small structures)

A system of pipes is necessary with each to transmit the steam or water and radiate the heat produced. Small systems are often "gravity flow" in which the water or steam is started in one section of the greenhouse at a relatively high elevation and flows by the pull of gravity downhill through the pipes which return to the boiler at the lower level. The gravity system is used for steam heating since much of the steam condenses into water in the pipes and must be returned to the boiler. Larger greenhouses must have pumps to help circulate the water and return the condensed steam.

The initial cost of installing steam heat is high but it is very efficient for many types of greenhouses. In addition to heating the growing house, the steam can be piped into the growing benches or beds in order to sterilize the soil, a practice of vital importance in the growing of quality plants. Steam sterilization helps to control plant diseases, weeds, soil insects, and nematodes. Greenhouses are cooled by using one of the following methods:

1. Fan and pad arrangement of washed air cooling

   Air is drawn through a moist pad mounted on the end or side of the greenhouse. The evaporation of the water cools the air.

2. High pressure fogs

   Water is broken up into a fine mist by being forced through nozzles at high pressure using turbine and triple piston pumps. The cooling effect of the mist may lower the temperature several degrees below the outside temperature of a shaded greenhouse.

Greenhouses are ventilated by:

1. Roof ventilating sash
2. Side sash

The trend in recent years has been toward power operation of the ventilating sash. Power vents are controlled by means of a thermostat which is set to the temperature required. Additional equipment in modern greenhouses may include:

1. Carbon dioxide generators
2. Fertilizer injection equipment
3. Automatic watering equipment
4. Turbulator fans
5. Misting systems
6. Bottom bench heat provided by heating cables
7. Relative humidity indicators
8. Temperature alarms
9. Day-night time clocks

Plants are grown on benches or directly in the ground. The arrangement of growing benches and aisles is very important. Most greenhouse catalogs include details for the most efficient arrangement of growing benches and aisle space.

Growing benches may be constructed of

1. Concrete
2. A combination of cement asbestos (transite)

   (Available in various widths, in smooth or corrugated sheets)
3. Wood - redwood or other wood treated with non-toxic preservatives
4. Iron frame and wood

There are advantages and disadvantages in using benches for growing plants.

Some advantages for using benches include:

1. It is a more convenient height for working.
2. Soil temperature and moisture can be more easily regulated.
3. There is better air circulation around plants grown in benches; and consequently the plants are less subject to disease.

Some disadvantages for using benches are

1. The soil dries out quickly.
2. All work must be done by hand.
3. They are expensive to build and maintain.

The height of the benches depends basically upon the height that is most convenient to the workers. The width of the benches depends upon

1. The width of the greenhouse
2. The arrangement of the benches in the greenhouse

3. The distance that one can reach in caring for plants. (Thirty inches is a common width for benches being worked from one side only, while benches which are worked from both sides are generally 66 inches wide or in a few cases, 72 inches wide.)

Greenhouses have been covered with glass for many years. However, various plastics and fiberglass have come into use. Plastic greenhouses are generally considered temporary structures and are usually of lighter construction. The initial cost of construction is lower, but there are indications that over an extended period of time, the cost advantage is nullified due to plastic replacement costs.

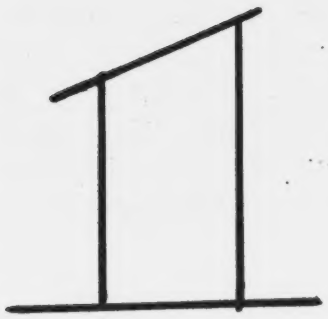
Fiberglass is more durable than most plastics, though the supporting structure most be of stronger construction in order to support the additional weight.

There are several types of greenhouses in use. They are classified by their roof types. A "lean-to greenhouse" is usually constructed against a building. It is, in effect, one half of a greenhouse split lengthwise and placed against a building.

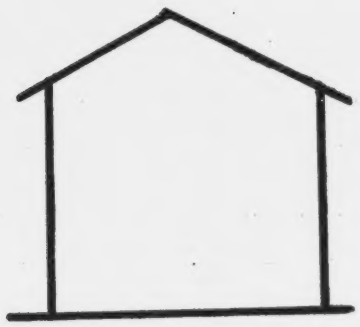
A detached greenhouse is most common. It consists of a roof which slopes in two directions, end and side walls. If attached to a building the attachment is at an end wall. The size of the structure can vary considerably. If only one crop is grown the larger structure is considered less expensive and easier to maintain. Smaller separate structures are advantageous if several crops with different requirements are grown.

Ridge and furrow greenhouses consist of two or more houses joined together at the gutter or sides of the house forming a series of ridges and valleys. Side walls between houses are eliminated, which permits coverage of large expanses of ground under one roof. Increased time for maintenance is needed with ridge and furrow houses since the roof sections are less accessable.

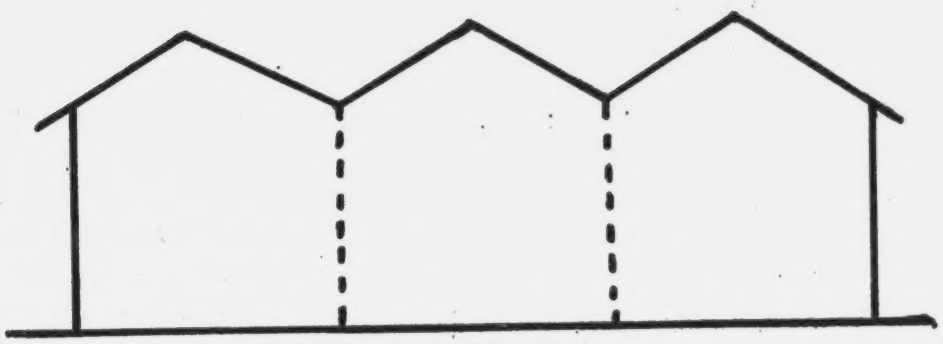
Types of Greenhouse Structures



Lean-to



Detached



Ridge and Furrow

Suggested Teaching-Learning Activities

1. Arrange a visit to local growers to observe first hand their plant growing structures and their use. To make the field trip more meaningful, students should have discussed and summarized in class types of plant growing structures.

   Students should pay particular attention to

   a. How the greenhouse is heated

   b. How the greenhouse is ventilated

   c. Whether raised benches or groundbeds are used for growing crops

   d. Automatic and/or special equipment used

2. Allow the students to examine blueprints of various growing structures. Determine if the students can identify the types of structures from the blueprints.

3. Obtain pictures (slides would be valuable) of as many different plant growing structures as possible from catalogs and magazines. Mount them individually on heavy paper. Use these as flash cards to help in identification.

4. If sufficient quantities of old horticultural magazines (popular and commercial) are available, assign each student or a group of students the task of researching information on a given type of plant growing structure. The articles could be on construction, design, maintenance, or operation.

Suggested Time to Develop the Competency

1. Classroom teaching	5	hours
2. School laboratory activity	3	hours
3. Total time	8	hours

Suggested Instructional Materials and References

Instructional materials

1. Pictures or slides of plant growing structures

2. Copies of various commercial and popular horticultural magazines. "Horticulture," "Flower and Garden," "Vegetable Grower," "Gardening Under Glass," "Florists' Review," "Grower Talks" are a few available horticultural magazines.

References

1. Christopher, Introductory Horticulture, pp. 141-154.

2. Laurie, Kiplinger, Nelson, Commercial Flower Forcing, pp. 12-14, pp. 28-32.

3. Research Report on Plastic Greenhouses, Virginia Agricultural Experiment Station.

4. Hotbeds and Coldframes. USDA.

5. Greenhouse Construction and Heating. USDA.

II. To develop an understanding of the construction of plant growing structures

Teacher Preparation

Subject Matter Content

Lathhouse construction varies according to precedent and the availability of materials. Posts are usually sunk into the ground and a support framework is built on these posts high enough to permit workers and equipment underneath. Lath or snow fencing is fastened to the support framework. If lath is used it is spaced one lath width apart. Usual recommendation is to orient the laths north and south. All wood which comes into contact with the soil should be treated with an insect and decay retardant.

Clothhouse construction consists of building a substantial frame upon which a cotton or Saran covering is placed.

Coldframe and hotbed construction varies according to the materials used. The following general rules apply regardless of construction materials. Standard sashes are 3 x 6 feet, consequently the frame dimensions should be 5' 11" wide. The frame can be any length as long as it is in multiples of 3 feet.

The front side of the frame should be 6 inches lower than the rear to allow water to runoff. The height of the frame is determined by the types of plants grown. A 12 inch front and 18 inch rear height are common for vegetable and bedding plants. Hotbeds are heated with electric cables buried in the ground, hot water or steam flows through pipes located inside and around the perimeter of the frame. For specific construction information consult state extension service bulletins or the references at the end of this section.

The construction of the sashhouse, hotbed, and coldframe is basically the same. The design usually calls for a double frame, (two frames back to back) built on sidewalls.

Glass greenhouse construction varies considerably. Older greenhouse frames were constructed entirely of wood. Pipe or iron frame greenhouses are still being used, but aluminum is becoming more popular.

Any wood used in greenhouse construction must be decay resistant. Cypress, which is difficult to obtain, and redwood are generally used.

Glass pane sizes vary, but 16" by 24" is most common. Some authorities recommend 20" by 20" glass. Double strength glass is needed to withstand the stresses and strains imposed by snow and hail on the roof.

A greenhouse is constructed by erecting a frame bedded in concrete. A frame may have support posts inside the greenhouse. Gutters of wood or metal are attached above the sidewall frame. The bars which support the glass are then attached. Painting, if necessary, is followed up by glazing or placing of the glass. Ventilators, doors, and other fixtures are then added.

Plastic or fiberglass greenhouse frames are generally constructed of wood, although several commercial models are aluminum. Some home-built designs incorporate the use of concrete reinforcing mesh of 4" or 6" openings.

The use of lighter plastics such as polyethylene requires a frame which holds down the plastic and prevents it from excessive billowing or flapping and tearing. The plastic is usually held down by lath batten strips nailed to the frame.

Suggested Teaching-Learning Activities

1. Provide a number of greenhouse supply catalogs. Refer to books when discussing various greenhouse structural parts. The illustrations are usually excellent. Use actual parts if available.

2. Assign groups of students to construct models of plant growing structures. The scale can be determined by time, materials available, and the dexterity of students. A suggested scale is 2 inches to one foot. Wooden vegetable and fruit crates are a suitable source of materials. Ordinary polyethylene or some of the clear kitchen food wraps are good glass substitutes.

3. Construction of a plant growing structure can be valuable experience. This should be attempted only if a sufficient amount of time is provided for the horticulture class. One hour periods are undesirable for this type of activitity. One of the blueprints examined in the previous competency area could be used as the guide for building a structure which would benefit the department and students.

4. Contact a local greenhouse builder who might be able to provide slides showing construction techniques. If possible, take students on field trips to observe the construction of a greenhouse. The objective of the trip can be the development of an understanding of construction details necessary for a good greenhouse.

Suggested Instructional Materials and References

Instructional materials

1. Tools and supplies necessary to construct model plant growing structures

2. Samples of roof bars, gutter sections double and single strength glass, and other available greenhouse parts.

3. Necessary tools and equipment for the construction of a plant growing structure on school grounds.

References

1. Laurie, Kiplinger, Nelson, Commercial Flower Forcing, pp. 14-22, 33-61.

2. Christopher, E. P. Introductory Horticulture, pp. 149-154.

3. Greenhouse Construction and Heating, USDA.

4. Hotbeds and Coldframes, USDA.

5. Plastic Greenhouses, University of Illinois

6. Construction of Plastic Greenhouses, Purdue University.

7. A Simple Rigid Frame Greenhouse for Home Gardeners, University of Illinois.

8. Catalog of Greenhouse Parts, Supplies, and Accessories, National Greenhouse Company.

9. State Extension Service Circulars.

Suggested Time to Develop this Competency

1. Classroom teaching	5	hours
2. School laboratory activity	10	hours
3. Total time	15	hours

Suggested Occupational Experience

Employment with greenhouse construction firm or with a grower who is constructing a greenhouse.

III. To develop the ability to effectively select and apply paint

Teacher Preparation

Subject Matter Content

Refer to the module: Using and Caring for Ornamental Plant Materials and Landscape Structures.

Suggested Teaching-Learning Activities

1. Distribute greenhouse parts and supply catalogs to students assigning various students to research and report on greenhouse paints and applicator equipment.

2. Discuss importance of exterior and interior painting of greenhouses and other plant growing structures. Discussion should result in an understanding of the following:

   a. Need for preserving wood against decay.

   b. Need for preventing excessive corrosion of metal parts.

   c. Need for preventing the drying out of glazing compounds.

   d. Need for high light reflective quality of interior structure of greenhouse.

   e. Aesthetic values of well maintained structures.

Suggested Instructional Materials and References

Instructional materials

Materials required in "paint use competency," Module: Using and Caring for Ornamental Plants and Landscape Structures.

References

1. Greenhouse supply catalogs
2. Module: Using and Caring for Ornamental Plants and Landscape Structures

IV. To develop the ability to glaze effectively

Teacher Preparation

Subject Matter Content

Glass is available in many sizes, grades and weights. The most commonly used glass for greenhouse glazing is labeled "double strength greenhouse quality." Single strength glass can be used; but for more satisfactory results double strength glass is recommended due to its greater resistance to stress and impact.

Trends in glass size for greenhouse use are toward large, square panes of glass called lights. Twenty by twenty inch lights are being used in most new greenhouse construction for several reasons. Wider bar spacing allows more light into the structure. Larger, square lights are more resistant to breakage than the smaller, rectangular shapes. Larger lights cut down on the amount of framing needed as well as construction time and costs.

A tightly glazed structure is important in quality plant production. All glass on the roof and on most vertical sections of a structure are overlapped 1/4" to 3/8". Water then rolls from one light to the next, running off the structure rather than leaking through it.

The bars onto which the glass is laid are grooved so that the glass will lie slightly below the surface of the bars. In order to prevent water leakage and slippage of the glass, a bedding compound or putty must first be placed in the groove. The usual procedure is to apply the putty the entire length of the bars onto which glass is to be laid. The first light of glass is laid at the

bottom or lower end and successive lights are placed above and overlapped 1/4" to 3/8". As each light is firmed into the putty, it is secured in place by driving glaziers' points into the bar tightly enough to hold down the light. Four glaziers' points are usually used for each light. Two are placed a few inches from the bottom of the light and two at the top preventing the edge of the next upper light from sliding downward.

Bar caps are used in many new greenhouses. They consist of a curved metal strip which fastens down over the bar. The cap seals and holds the galss firmly. Bar caps minimize maintenance by preventing excessive drying and cracking of the putty.

Reglazing is occasionally necessary because of dried putty or broken lights. It is very important to completely clean out all old putty before applying the new. Old putty may be quite hard and the careful use of a torch may be necessary to soften it for removal.

Glass cutting is not as difficult as it appears. Work on a flat surface. Dip the cutter in a light motor oil. Place cutter between first and second fingers similar to holding a pencil. Start the wheel on the far side of the glass holding the cutter erect. Press just hard enough to make a fine hard line. Run the cutter wheel over the glass only once. Break the glass by bending it along the cut.

A variety of plastic materials are available for glazing plant growing structures. Basic procedures of application require wooden, lath strips nailed over the plastic into the frame to hold down the material. Poultry netting or similar material can be placed under the plastic before application and sometimes on top of it in order to prevent billowing and reduce wind damage.

Suggested Teaching-Learning Activities

1. Use greenhouse supply catalogs to familiarize students with supplies and equipment used in glazing. Bring in these items for class observation.

2. Obtain several used sash, or construct a frame of two greenhouse bars on which students can practice glazing. Have students work in pairs. The next two students can clean the frame and reglaze.

3. Practice glass cutting. Use new glass since aged lights may not cut properly. Emphasize safety procedures.

Suggested Time to Develop this Competency

1. Classroom teaching ___1___ hours
2. School laboratory activity ___14___ hours
3. Total time ___15___ hours

Suggested Instructional Materials and References

Instructional materials

1. Assorted glazing supplies and equipment.
2. Used sash or a frame constructed with two greenhouse bars spaced to fit the size of available glass.
3. Supply of putty or bedding compound, glass, glaziers' points, glaziers' hammer, pliers, and gloves.
4. Supply of new glass, glass cutters, light oil, straight edge, and gloves.

References

1. Greenhouse supply catalogs.
2. Laurie, Kiplinger, Nelson, Commercial Flower Forcing, pp. 23-27.

V. To develop the abilities necessary to grow greenhouse crops

Teacher Preparation

Subject Matter Content

This is covered in the publication, Using the School Greenhouse, which is included with this module. Through the production of Chrysanthemums, Daffodils, and vegetable transplants, students can learn practical greenhouse management practices.

Suggested Teaching-Learning Activities

1. Perform the controlled experiments in Using the School Greenhouse.

2. Offer appropriate instructions to the class from modules entitled Plant Propagation and Growing Horticultural Crops.

Suggested Time to Develop this Competency

1.	Classroom teaching	1 hours
2.	School laboratory activity	14 hours
3.	Total time	15 hours

Suggested Occupational Experience

Employment with greenhouse operator or grower using other plant growing structures. The student should:

1. Handle routine maintenance such as painting and glazing.
2. Assist in management of crops grown in greenhouses or other plant growing structures.

Suggestions for Evaluating Educational Outcomes of the Module

Upon completion of this module, students should have competency in the following activities. They should:

1. Identify and know the use of various plant growing structures.
2. Know the rudiments of construction of various plant growing structures.
3. Know routine maintenance procedures for plant growing structures.
4. Know basic greenhouse management.

Check list for Evaluating Student Competency

1. Can students identify and explain the use of each plant growing structure studied?
2. Can the student explain basic construction of plant growing structures?
3. Can the student select and properly apply paint?
4. Can the student cut glass properly?
5. Can the student glaze properly?

6. Can the student identify the five environmental factors which affect plant growth?

7. Can the student recognize the effects of these environmental factors on plants?

8. Does the student understand the timing of chrysanthemums, easter lilies or poinsettias for bloom on a specific date?

9. Does the student understand the forcing of bulbs?

10. Does the student understand the production of vegetable plants from seed?

Sources of Suggested Instructional Materials and References

1. A Simple Rigid Frame Greenhouse for Home Gardeners. Circular 880, University of Illinois, College of Agriculture, Cooperative Extension Service, Urbana, Illinois.

2. Catalog of Greenhouse Parts, Supplies, and Accessories. National Greenhouse Company, Main Office, Pana, Illinois.

3. Construction of Plastic Greenhouse. Circular 492, Purdue University, Agricultural Extension Service, Lafayette, Indiana.

4. Plastic Greenhouses. Circular 857, University of Illinois, College of Agriculture, Cooperative Extension Service, Urbana, Illinois

5. Research Report on Plastic Greenhouses. Research Report No. 63, Virginia Experimental Station, Blackburg, Virginia.

6. Laurie, Alex; Kipling, D. C.; Nelson, Kenard S. Commercial Flower Forcing, Sixth Edition, New York: McGraw-Hill Book Company, 1958.

7. Christopher, E. P. Introductory Horticulture, New York: McGraw-Hill Book Company. 1959.

8. "Greenhouse Construction and Heating," Superintendent of Documents, U. S. Government Printing Office, Washington, D. C.

9. F. B. #1743, "Hotbeds and Coldframes," Superintendent of Documents, U. S. Government Printing Office, Washington, D. C.

THE CENTER FOR RESEARCH AND LEADERSHIP DEVELOPMENT
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THE OHIO STATE UNIVERSITY
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INSTRUCTOR NOTE: As soon as you have completed teaching each module, please record your reaction on this form and return to the above address.

1. Instructor's Name_____

2. Name of school_____State_____

3. Course outline used: _____Agriculture Supply--Sales and Service Occupations
   _____Ornamental Horticulture--Service Occupations
   _____Agricultural Machinery--Service Occupations

4. Name of module evaluated in this report_____

5. To what group (age and/or class description) was this material presented?____
   _____

6. How many students:
   a) Were enrolled in class (total) _____
   b) Participated in studying this module _____
   c) Participated in a related occupational work experience program while you taught this module _____

7. Actual time spent teaching module:

		Recommended time if you were to teach the module again:
_____hours	Classroom Instruction	_____hours
_____hours	Laboratory Experience	_____hours
_____hours	Occupational Experience (Average time for each student participating)	_____hours
_____hours	Total time	_____hours

(RESPOND TO THE FOLLOWING STATEMENTS WITH A CHECK (√) ALONG THE LINE TO INDICATE YOUR BEST ESTIMATE.)

	VERY APPROPRIATE	NOT APPROPRIATE
8. The suggested time allotments given with this module were:	
9. The suggestions for introducing this module were:	
10. The suggested competencies to be developed were:	
11. For your particular class situation, the level of subject matter content was:	
12. The Suggested Teaching-Learning Activities were:	
13. The Suggested Instructional Materials and References were:	
14. The Suggested Occupational Experiences were:	

(OVER)

15. Was the subject matter content sufficiently detailed to enable you to develop the desired degree of competency in the student? Yes_____No_____
Comments:

16. Was the subject matter content directly related to the type of occupational experience the student received? Yes_____No_____
Comments:

17. List any subject matter items which should be added or deleted:

18. List any additional instructional materials and references which you used or think appropriate:

19. List any additional Teaching-Learning Activities which you feel were particularly successful:

20. List any additional Occupational Work Experiences you used or feel appropriate:

21. What do you see as the major strength of this module?

22. What do you see as the major weakness of this module?

23. Other comments concerning this module:

_____ _____
(Date) (Instructor's Signature)

_____
(School Address)